

**WE CLAIM:**

1. A method of collecting experimental data on a computer system, comprising  
the steps of :

initializing a container, using configuration information wherein the container

5 includes a plurality of sub-containers;

storing configuration information used for the container in a container database;

repeating steps (a)-(g) for desired sub-containers in the container:

(a) selecting an individual sub-container in the container,

(b) collecting a plurality of image data from the sub-container,

10 (c) storing the plurality of image data in an image database,

(d) collecting a plurality of feature data from the image data,

(e) storing the plurality of feature data in a feature database,

(f) calculating a plurality of sub-container summary data using the

plurality of image data and the plurality of feature data collected from the sub-container,

15 and

(g) storing the plurality of sub-container summary data in a sub-container

database;

calculating a plurality of container summary data using the plurality of sub-  
container summary data from the sub-container database; and

20 storing the plurality of container summary data in the container database.

2. A computer readable medium having stored therein instructions for causing a  
central processing unit to execute the method of Claim 1.

3. The method of Claim 1 wherein the plurality of sub-containers include a plurality of cells treated with an experimental compound.

5           4. The method of Claim 1 wherein the container includes a microplate, and the plurality of sub-containers includes wells in a microplate.

5. The method of Claim 1 wherein the container database includes microplate data, the sub-container database includes well data, the image database includes  
10   photographic image data and the feature database includes cell feature data.

6. The method of Claim 1 wherein the step of collecting a plurality of feature data from the image data includes collecting any of: size, shape, intensity, texture, location, area, perimeter, shape factor, equivalent diameter, length, width, integrated  
15   fluorescence intensity, mean fluorescence intensity, variance, skewness, kurtosis, minimum fluorescence intensity, maximum fluorescence intensity, geometric center, an X-coordinate of a geometric center or a Y-coordinate of a geometric center for cells.

7. The method of Claim 1 wherein the step of calculating a plurality of sub-  
20   container summary data includes calculating any of: sizes, shapes, intensities, textures, locations, nucleus area, spot count, aggregate spot area, average spot area, minimum spot area, maximum spot area, aggregate spot intensity, average spot intensity, minimum spot intensity, maximum spot intensity, normalized average spot intensity, normalized spot

count, number of nuclei, nucleus aggregate intensity dye area, dye aggregate intensity, nucleus intensity, cytoplasm intensity, difference between nucleus intensity and cytoplasm intensity, nucleus area, cell count, nucleus box-fill ration, nucleus perimeter squared area or nucleus height/width ratio.

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8. The method of Claim 1 wherein the step of calculating a plurality of container summary data includes calculating any of: mean size, mean shape, mean intensity, mean texture, locations of cells, number of cells, number of valid fields, standard deviation of nucleus area, mean spot count, standard deviation of spot count, mean aggregate spot  
10 area, standard deviation of aggregate spot area, mean average spot area, standard deviation of average spot area, mean nucleus area, mean nucleus aggregate intensity, standard deviation of nucleus intensity, mean dye area, standard deviation of dye area, mean dye aggregate intensity, standard deviation of aggregate dye intensity, mean of minimum spot area, standard deviation of minimum spot area, mean of maximum spot  
15 area, standard deviation of maximum spot area, mean aggregate spot intensity, standard deviation of aggregate spot intensity, mean average spot intensity, nuclei intensities, cytoplasm intensities, difference between nuclei intensities and cytoplasm intensities, nuclei areas, nuclei box-fill ratios, nuclei perimeter squared areas, nucleus height/width ratios, well cell counts.

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9. The method of Claim 1 wherein the container includes a bio-chip and the plurality of sub-containers include selected micro-gels on the bio-chip.

10. The method of Claim 1 further comprising:

storing the container database data and the sub-container database data in a second database on a shared database;

5 storing the image database and the feature database data in a plurality of third databases on a shared database file server; and

creating links in a first database to the second database and the plurality of third databases, wherein the first database includes links to the second database and the plurality of third databases but does not include any data collected from the container, and wherein the first database is used by a display application to view data collected from  
10 a container.

11. The method of Claim 10 wherein the shared database includes faster access local storage.

15 12. The method of Claim 10 wherein the shared database file server includes slower access remote storage.

13. A method of storing experimental data on a computer system, comprising the steps of:

20 collecting a plurality of image data and a plurality of feature data from a plurality of sub-containers in a container;

creating a first database, wherein the first database includes links to other databases but does not include any data collected from the container, and wherein the

first database is used as a pass-through database by a display application to view data collected from a container;

creating a first entry in the first database linking the first database to a second database, wherein the second database includes configuration data used to collect data from the container, summary data for the container calculated from the plurality of sub-containers and summary data for sub-containers in the container calculated from the plurality of image data and plurality of feature data, and wherein the data is organized in a plurality of tables; and

creating a plurality of second entries in the first database linking the first database to a plurality of third databases, wherein the plurality of third databases include a plurality of image data and a plurality of feature data collected from the plurality of sub-containers in the container, and wherein the data is organized in a plurality of tables.

14. A computer readable medium having stored therein instructions for causing a central processing unit to execute the method of Claim 13.

15. The method of Claim 13 wherein the plurality of sub-containers include a plurality of cells treated with an experimental compound.

16. The method of Claim 13 wherein the container includes a microplate, and the plurality of sub-containers include wells in the microplate.

17. The method of Claim 13 wherein the container includes a bio-chip and the plurality of sub-containers include selected micro-gels on the bio-chip.

18. The method of Claim 13 wherein the plurality of feature data includes a  
5 plurality of cell feature data for a plurality of cells in the sub-container and the plurality of image data includes a plurality of photographic images collected from the plurality of cells in a sub-container.

19. The method of Claim 13 wherein the first database is a pass-through database  
10 and does not include any data collected from the container.

20. The method of Claim 13 wherein the first database includes an application database comprising a plurality of pass-through tables including a plurality of entries  
15 linking the application database to other databases.

21. The method of Claim 13 wherein the second database includes a system database comprising a plurality of database tables including any of: plate, protocol, protocol assay parameter, protocol scan area, assay parameters, protocol channel,  
20 protocol channel reject parameters, manufacturer, form factor, plate feature, well, well feature, system or feature type database tables.

22. The method of Claim 13 wherein the third database is a plate database comprising a plurality of database tables including any of: well, well feature, feature type well field, well field feature, well field feature image, cell or cell feature tables.

5           23. The method of Claim 22 wherein the third database further includes any of plate, protocol, protocol assay parameter, protocol scan area, assay parameter, protocol channel, protocol channel reject parameter, manufacturer, form factor, plate feature, well system or feature type database tables so the third database can be archived and copied to another computer system for review without copying the second database to another  
10   computer system.

24. The method of Claim 13 wherein the step of collecting a plurality of image data and a plurality of feature data from a plurality of sub-containers in a container comprises the steps of:

- 15           initializing a container using configuration information;  
            storing configuration information use for the container in the second database;  
            repeating steps (a)-(g) for desired sub-containers in the container:
- (a)    selecting an individual sub-container in the container,
  - (b)    collecting a plurality of image data from the image data,
  - 20    (c)   storing the plurality of image data in a third database,
  - (d)    collecting a plurality of feature data from the image data,
  - (e)    storing the plurality of feature data in the third database,

(f) calculating a plurality of sub-container summary data using the plurality of image data and the plurality of feature data collected from the sub-container,

(f) storing the plurality of sub-container summary data in the second database,

5 calculating a plurality of container summary data for the container using the plurality of sub-container information from the second database; and

storing the plurality of container summary data in the second database.

25. The method of Claim 13 wherein the first database is stored on a personal  
10 computer, the second database is stored on a database server and the plurality of third databases are stored on a shared database file server.

26. The method of Claim 13 wherein the step of collecting a plurality of image data and a plurality of feature data from a plurality of sub-containers in a container  
15 includes collecting a plurality of photographic image data and a plurality of cell feature data for a plurality of cells from a plurality of wells in a microplate for a pre-determined assay for an experimental compound.

27. A method for spooling experimental data on a computer system, the method  
20 comprising the steps of:

copying a second database from an analysis instrument to a shared database,  
wherein the second database includes configuration data used to collect data from a container, summary data for the container calculated from a plurality of sub-containers in



the container and summary data for sub-containers in the container calculated from a plurality of image data and plurality of feature data collected from desired sub-containers, and wherein the data in the second database is organized into a plurality of database tables;

- 5           copying a plurality of third databases from an analysis instrument to a shared database file server, wherein the plurality of third databases include a plurality of image data and a plurality of feature data collected from the plurality of sub-containers in the container, and wherein the data is organized in a plurality of database tables; and
- updating the location of the second database and the plurality of third databases in
- 10   a first database on the analysis instrument to reflect new storage locations for the second database on the shared database and the plurality of third databases on the shared database file server, wherein the first database is a pass-through database that includes links to the second database and plurality of third databases but does not include any data collected from the container, and wherein the first database is used by a display
- 15   application to view data collected from a container.

28. A computer readable medium having stored therein instructions for causing a central processing unit to execute instructions for the method of Claim 27.

- 20           29. The method of Claim 27 further comprising:
- copying the first database from the analysis instrument to a local storage location on a store client computer to allow a display application on the store client computer to view the data collected from the container; and

viewing the data collected from the display application on the store client computer by using the first database to retrieve container and sub-container data from the second database on the shared database and image and feature data from the plurality of third databases on the shared database file server.

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30. The method of Claim 27 further comprising:

locating the first database from a store client computer at a remote location to allow a display application on the store client computer to view the data collected from the container; and

10 viewing the data collected from the display application on the store client computer by using the first database at the remote location to retrieve container and sub-container data from the second database on the shared database and image and feature data from the plurality of third databases on the shared database file server.

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31. The method of Claim 27 wherein the container includes a microplate, and the plurality of sub-containers included wells in the microplate.

32. The method of Claim 27 wherein the container includes a bio-chip and the  
20 plurality of sub-containers include selected micro-gels on the bio-chip.

33. The method of Claim 27 wherein the plurality of sub-containers include a plurality of cells treated with an experimental compound.

34. The method of Claim 27 wherein the shared database includes faster access local storage.

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35. The method of Claim 27 wherein the shared database file server includes slower access remote storage.

36. A method for managing multiple database files in a database, comprising the  
10 steps of:

initializing a hierarchical storage manager with a pre-determined storage removal policy;

applying the pre-determined storage removal policy to database files in a database from the hierarchical storage manager;

15 determining whether any database files in the database match the pre-determined storage removal policy, and if so,

copying the database files from the database to a layer in a multi-layered hierarchical store management system, and

replacing the database files in the database with placeholder files, wherein  
20 the placeholder files include links to the actual database files in the layer in the hierarchical store management system.

37. A computer readable medium having stored therein instructions for causing a central processing unit to execute the method of Claim 36.

38. The method of Claim 36 wherein the pre-determined storage removal policy  
5 includes a plurality of rules including any of: percentage of disk space available, percentage of disk space used, number of files, date a file is stored, size of a file, number of days since a file was last accessed, file name or file type.

39. The method of Claim 36 wherein the multi-layer hierarchical store  
10 management system includes layers for any of: a disk archive, an optical jukebox, or a digital linear tape.

40. A method for presenting experimental data from a plurality of databases, comprising the steps of:

15 displaying a list including a plurality containers using a first database from a display application on a computer, wherein the first database is a pass-through database, wherein the containers include a plurality of sub-containers, and wherein a plurality of image data and a plurality of feature data were collected from the plurality of containers;

receiving a first selection input on the display application for a first  
20 container from the list including a plurality of containers;

obtaining a second database for the first container from a first remote storage location, wherein the second database includes configuration data used to collect data from the first container, summary data for the first container calculated from a

plurality of sub-containers in the first container and summary data for desired sub-containers in the first container calculated from a plurality of image data and plurality of feature data collected from desired sub-containers;

receiving a second selection input on the display application for one or  
5 more sub-containers in the first container;

obtaining a plurality of third database from a second remote storage location, wherein the plurality of third databases include a plurality of image data and a plurality of feature data collected from the one or more sub-containers in the first container;

10 creating a graphical display from the display application including container and sub-container data from the second database, image data and feature data from the plurality of third databases collected from the one or more sub-containers, wherein data displayed on the graphical display will appear to be obtained from local storage on the computer instead of the first remote storage location and the second remote  
15 storage location.

41. A computer readable medium having stored therein instructions for causing a central processing unit to execute the method of Claim 40.

20 42. The method of Claim 40 wherein the container includes a microplate, and the plurality of sub-containers include wells in the microplate.

43. The method of Claim 40 wherein the container includes a bio-chip and the plurality of sub-containers include selected micro-gels on the bio-chip.

44. The method of Claim 40 wherein the plurality of sub-containers include a  
5 plurality of cells treated with an experimental compound.

45. The method of Claim 40 wherein the first remote storage location and the second remote storage location include any of: a shared database, a shared database file server, a disk archive, an optical jukebox, or a digital linear tape in a location remote to  
10 the computer including the display application.

46. The method of Claim 40 wherein the second database includes a system database and wherein the plurality of third databases include a plurality of image and feature databases.

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47. The method of Claim 40 wherein the first database does not include any data collected from the container.

48. The method of Claim 40 wherein the step of displaying a list including a  
20 plurality containers using a first database from a display application on a computer includes locating the first database at a location remote to the computer and displaying a list from the display application on the computer using the first database at the remote location.

49. A data storage system, comprising in combination:
- a shared database on a local area network for storing summary data collected for a plurality of wells in a microplate and for a summary data microplate;
  - 5 a shared database file server on a local area network for storing image data and feature data collected from a plurality of wells in a microplate;
  - a hierarchical storage management system on a local area network with a plurality of layers for archiving data from the shared database and the shared database file server comprising:
    - 10 a disk archive layer,
    - an optical jukebox layer,
    - a digital linear tape layer,
    - a store server on a local area network for managing data from the shared database, the shared database file server, and the hierarchical storage management
    - 15 system; and
    - a pass-through database with multiple links providing access to database files stored on the shared database, the shared database file server, and the hierarchical storage management system, wherein the pass-through database is used by a display application on a computer to display experimental data from the database files; and
    - 20 an application programming interface for providing a programming interface to the shared database, shared database file server, and the hierarchical storage management system.

50. A computer readable medium having stored therein a plurality of application programming interface function interfaces for collecting and managing experimental data, the computer readable medium comprising in combination:

a programming interface for collecting a plurality of image data and feature data

5 from desired sub-containers in a container;

a programming interface for storing image data and feature data collected from desired sub-containers in a container, for storing sub-container summary data calculating using the image data and the feature data collected from the sub-container, and for storing container summary data calculating using the sub-container summary data;

10 a programming interface for spooling image data and feature data collected from desired sub-containers in a container, sub-container summary data calculating using the image data and the feature data collected from the sub-container, container summary data calculating using the sub-container summary data from local storage locations on network device used to collect the data to remote storage locations on a computer

15 network;

a programming interface for managing multiple database files in a database by applying a pre-determined storage removal policy to database files in a database from a hierarchical storage manager, copying the database files from the database to a layer in a multi-layered hierarchical store management system, and replacing the database files in  
20 the database with placeholder files, wherein the placeholder files include links to the actual database files in the layer in the hierarchical store management system; and

a programming interface for presenting experimental data from a plurality of databases at remote locations, the plurality of databases including image data and feature



data collected from desired sub-containers in a container, sub-container summary data calculating using the image data and the feature data collected from the sub-container, container summary data calculating using the sub-container summary data.

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